**Report in the biology of the problem**

Using a microscope, we take images of the population of cells, which are located in a different phase. By utilizing the word “phase” we imply a specific timeline in the cell’s life. It’s known that a cell begins its life and after a sufficient amount of time it multiplies, behaving naturally to life. This multiplication is done by geometric progression, due to the fact that when the cell multiplies it actually splits in two, it’s bisected. On the chart below we can notice the life line of the cell according to the different phases we depict.

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Assuming an image from the microscope, we cannot distinguish many details because the core by itself doesn’t have any pigment. Therefore we color the core with different pigments. This is accomplished by various tools which are categorized in detail below:

* Antigen ΚΙ67, is a nuclear protein which is formed and is crucial with the cell multiplication. Also it’s connected to the ribosomal ΡΝΑ. The antigen’s neutralization leads to the PNA composition’s suspension. The protein Ki-67 (also known as MKI67) is a cell indicator closely connected with multiplication. While the duration of the interphase, antigen Ki-67 can be detected only on the inside of a cell’s core, whilst in the mitosis phase a bigger part of the protein is transferred on the surface of the chromosomes. The protein Ki-67 is present in the duration of all the phases of the active cell cycle (G1, S, G2, and mitosis), but is absent from resting cells (G0).
* DAPI is a fluorescent coloring which is connected intensely with rich areas by adenines thymine on the DNA. It’s extensively used in microscopic fluorescence. DAPI can move intact through the cell membrane , therefore can be used on live and dead cells. Even though they move through the membrane in live cells, less efficiently.

According to what’s been stated above, we can make the cores visible to microscopes and can finally talk and make conclusions on the state of the cores.

**The issue**

The issue is to calculate, by using an algorithm, the phases of a core. The data for the cores we have acquired are: the number, their location on an image and the coloring they have received.

Corresponding to the images we obtained from the microscope we can create plenty of different criteria to contrast the cores in relation to their phase. These criteria can be named “measurements” of the cores. We can consider a lot of types of measurements, where only a fracture will be linearly independent, which means that they won’t co-depend. Some thoughts for the creation of the measurements, according to the pictures we have received are stated below:

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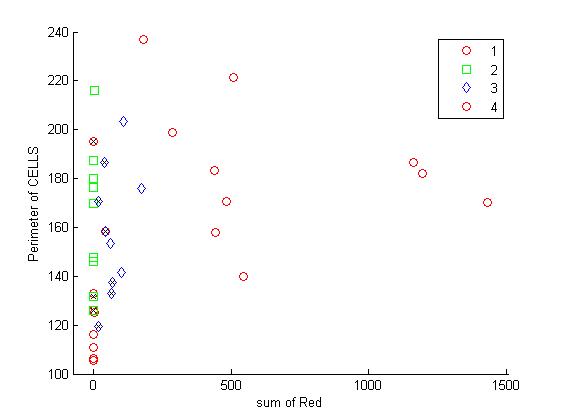
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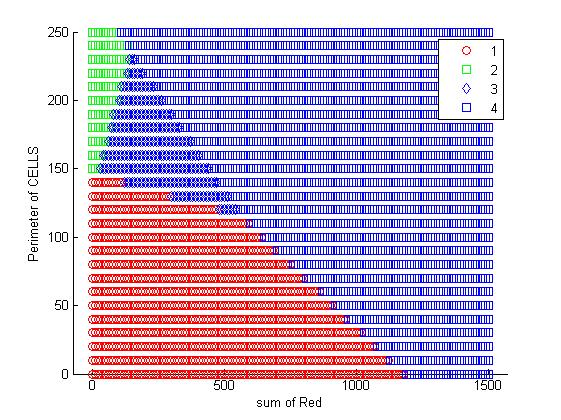
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Afterwards, we take a multitude of cores and set its category (phase). From what has been stated above we create diagrams of the linear independent, by utilizing the measurement 1 on the horizontal axis and the measurement 2 on the vertical axis. Using these charts if we navigate the known phase cells, there are created areas of cell phases. Moreover, areas created which if they had the measurement of a core and categorizes itself in that area would mean that that core belongs in that specific phase.



Above, we notice the known cores create in two measurements, areas of phases. Then, by using the method of quadratic discriminant analysis, results into the graph below



According to that method, every Y class produces X data by using a multivariate normal allocation. The model assumes X data from a GAUSS allocation. For the quadratic discriminant analysis , both values , means and covariance of every category changes. This algorithm has as criteria the prediction-classificication so the expected cost of ranking would be minimized.

Using the above algorithm and utilizing the linearly indepented measurements we create 4 criteria and then we execute for all the multitude of cores and concider each core’s phase.

Evaluation of the algorithm classificiation

The executable algorithm takes in concideration the above measurements and classifies the cores which results by the image.

For the correct utilization of the above algorithm it would be wise to report the error of its outcome. According to what has been stated , a new algorithm is created which can produce the said algorithm's error.

A method for exporting the error is :

1. By applying a population of cores which is known at which state they are.

2. By running the algorithm of its classification on the population.

3. In conclusion we compare and contrast the state of every core (G0,G1-S,G2,M) of the said population , with the state which resulted from using this algorithm.

The advantage of using this method (error of classification) is a valid estimation of the algorithm's error.